



The transverse acetabular ligament: an aid to orientation of the acetabular component during primary total hip replacement

A PRELIMINARY STUDY OF 1000 CASES INVESTIGATING POST-OPERATIVE STABILITY

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Ensuring the accuracy of the intra-operative orientation of the acetabular component during a total hip replacement can be difficult. In this paper we introduce a reproducible technique using the transverse acetabular ligament to determine the anteversion of the acetabular component. We have found that this ligament can be identified in virtually every hip undergoing primary surgery. We describe an intra-operative grading system for the appearance of the ligament. This technique has been used in 1000 consecutive cases. During a minimum follow-up of eight months the dislocation rate was 0.6%. This confirms our hypothesis that the transverse acetabular ligament can be used to determine the position of the acetabular component. The method has been used in both conventional and minimally-invasive approaches.

In total hip replacement (THR) malposition of the acetabular component may lead to dislocation, impingement, wear and revision.¹⁻⁹ This aspect of THR has not been lessened by the use of minimally-invasive techniques.^{10,11}

Currently, many surgeons depend on precise positioning of the patient to orientate the acetabular component. However, this method cannot always be relied on.^{2,12,13} Although computer-assisted surgery¹⁴⁻¹⁷ has the potential to improve accuracy, the early results have been disappointing,^{16,18,19} with controversy continuing to exist regarding the optimal orientation.²⁰

The aim of this paper is to present the preliminary data on a technique which uses the transverse acetabular ligament to determine the anteversion of the acetabular component and to determine the effect of such positioning on the risk of dislocation. This technique was the sole method of determining the version of the component in 1000 consecutive primary THRs performed by the senior author (DB) using both conventional and minimally-invasive approaches.

Patients and Methods

Between October 2002 and March 2005, 1000 consecutive patients underwent primary THR by the same surgeon (DB). This included 400 who had the operation through an incision of less than 10 cm in length. Of these latter patients, 104 were part of a separate prospective randomised controlled trial.²¹ The mean

age of the 463 men and 537 women at the time of operation was 68.3 years (25 to 92). The indication for the primary THR was pain arising from idiopathic osteoarthritis in 936 patients (23 rapidly progressive), inflammatory arthritis in 28, osteoarthritis secondary to osteonecrosis in nine, osteoarthritis secondary to congenital dysplasia of the hip in six, post-traumatic arthritis in 15, osteoarthritis secondary to a septic arthritis in two, and osteoarthritis secondary to slipped upper femoral epiphysis in four patients.

Operative technique. A posterolateral approach was used to insert a cementless acetabular component (Duraloc or Pinnacle; DePuy International Ltd., Warsaw, Indiana); the femoral component was either a custom-made cemented titanium component or a cemented C-stem (Depuy International Ltd, Leeds, United Kingdom) with a 28 mm head. Ceramic-on-ceramic bearings were used in patients under 60 years of age, while ceramic-on-polyethylene were used in patients aged 60 to 65 years and those over 65 years of age had metal-on-polyethylene bearings.

A neutral 28 mm acetabular liner was used in 973 cases. In 27 cases an acetabular liner with a 10° lip was used. In 18 of these the lip was positioned superiorly to compensate for the fact that the component had been left open to maximise bone cover in cases with superior bone loss. In the remaining nine it had been inadvertently inserted in more than 5° of retroversion with respect to the transverse acetabu-

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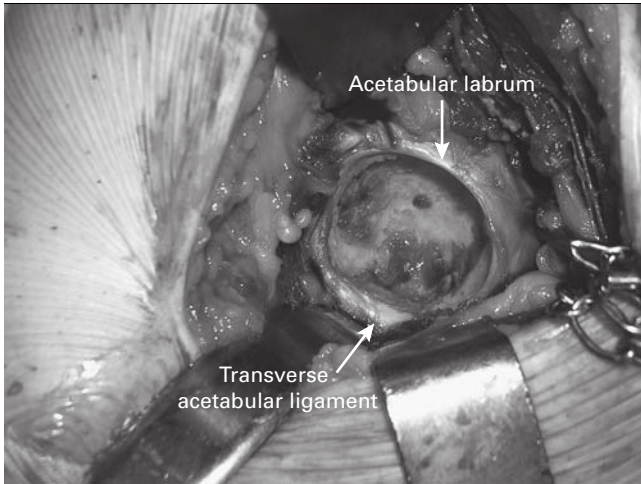


Fig. 1

A 360° fixed-window exposure of the acetabulum, with exposure of the acetabular labrum and transverse acetabular ligament (grade 1).

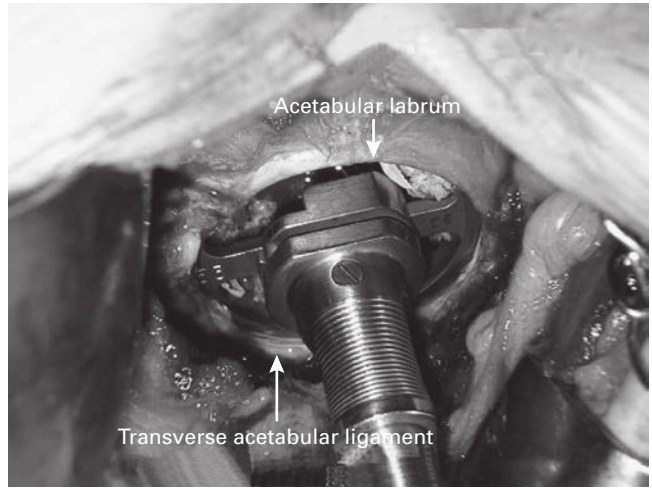


Fig. 2

The transverse acetabular ligament cradling the final acetabular reamer (representing the functional inlet plane of the acetabulum).

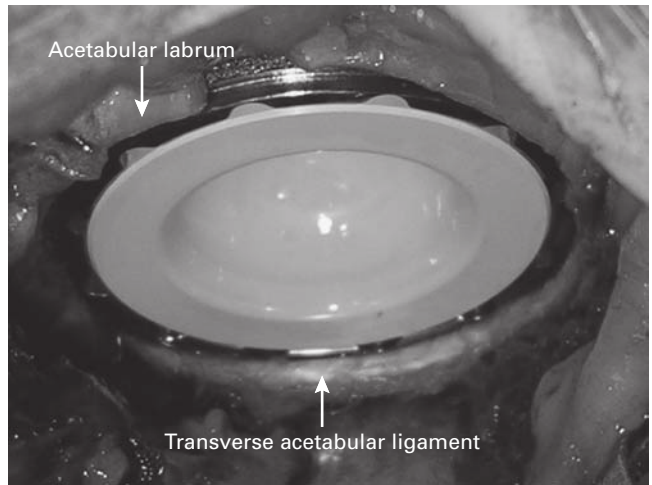
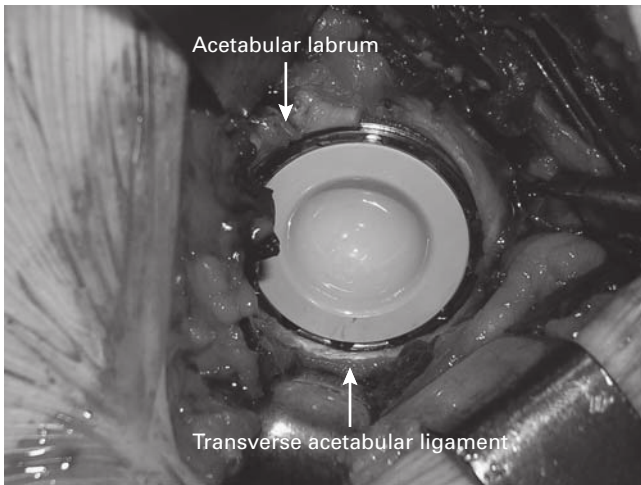


Fig. 3

Final orientation of the acetabular component using the transverse acetabular ligament/labrum technique.

Table I. Intra-operative classification of the transverse acetabular ligament (TAL) and the number of each grade identified in the 1000 total hip replacements (THR)

Grade of TAL	The appearance of the TAL as seen during THR	Number of each grade identified (%)
1	Normal-quality TAL visible on exposure of the acetabulum	490 (49.0)
2	TAL covered by soft tissue, which needed to be cleared to expose the ligament	351 (35.1)
3	TAL covered by osteophytes, which have to be removed to expose the ligament	156 (15.6)
4	No ligament identified, even after adequate clearance of soft tissue or osteophytes	3 (0.3)

Not infrequently the TAL was of mixed grade: for example, part of it was grade 1 and easily visible, but another part was covered in bone (grade 3). Rather than create additional grades, those that were of mixed were graded according to the most predominant grade

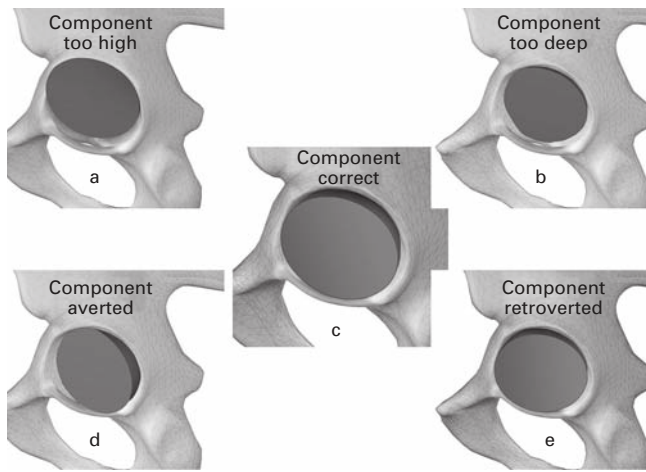


Fig. 4

The acetabular component sitting, a) high, b) deep, c) at the correct height, depth and version, d) at the correct height and depth, but anteverted, and e) at the correct height and depth, but retroverted.

Table II. Overview of the literature on the incidence of post-operative dislocation following total hip replacement (THR) by a posterior approach with a posterior repair

Authors	Number of dislocations	Number of THRs	Incidence of dislocation (%)
Goldstein et al ²⁵	3	500	0.6
Weeden et al ²⁶	8	945	0.85
van Stralen et al ²⁷	12	884	1.36
White et al ²⁸	3	437	0.7
Suh et al ²⁹	1	96	1
Dixon et al ³⁰	1	255	0.4
Archbold et al (present study)	6	1000	0.6

lar ligament, and the lip was then placed posteriorly. In all cases retractors were used to obtain full exposure of the acetabulum (Fig. 1). Inferiorly, this was achieved by using a teardrop retractor, which was placed such that the transverse acetabular ligament remained superficial to it. The appearance of this ligament was graded using a system developed in-house (Table I). Where the ligament was covered by osteophyte (grade 3), acetabular reamers were used to remove overlying bone to expose it. To achieve this, a small-diameter acetabular reamer was used. This should be done with care, because excessive reaming could potentially transform a grade 3 ligament into a grade 4 by destroying it.

Once defined, the transverse acetabular ligament is used as a guide to acetabular reaming (Fig. 2). When functioning normally the ligament acts as a tension band between the posteroinferior and anteroinferior aspects of the acetabulum, resisting anteroposterior widening during loading of

the joint.²² To restore the anatomy, the ligament should embrace the final acetabular reamer (Fig. 2) and thereby, the acetabular component (Fig. 3). If there is a gap between the ligament and the reamer the acetabular component will sit too high (Fig. 4a). If the reamer is hemispherical, its inferior superficial edge should sit just inside the ligament. This acts as a control for depth as well as for height (Fig. 4b). When bone loss is present the cementless cup has to be placed deep to the ligament. In this situation an offset liner can be used to restore depth so that the face of the liner sits almost flush with the caudal edge of the ligament (Fig. 4c).

Thus the transverse acetabular ligament can be used to control acetabular depth, height and version. If the face of the reamer, and subsequently the acetabular component, is kept parallel to the ligament, we feel that this represents the natural version for that patient (Fig. 4c). Anteversion is demonstrated in Figure 4d and retroversion in Figure 4e. As the ligament cannot define the inclination of the component, this may be assessed with the residual labrum. By orientating the reamer, and hence the acetabular component, flush with the residual labrum, inclination can be controlled (Figs 2 to 4).

During closure, the capsule and short external rotators were individually reattached to the trochanter with number 5 Ethibond, using drill holes. Standard precautionary advice was given to the patient after the operation and no other specific action was taken to avoid dislocation. Where possible, the patients were mobilised on the day after surgery and were discharged when they were mobilising independently. The mean post-operative stay was 4.2 days (2 to 27).

Results

The transverse acetabular ligament was identified and exposed in 99.7% of cases (Table I). At a minimum follow-up of eight months (8 to 41) six of the 1000 hips (0.6%) had dislocated, all posteriorly.

Discussion

The transverse acetabular ligament forms a bridge across the inferior acetabular notch, continuing the outer edge of the acetabulum.²² In this region it is effectively the continuation of the acetabular labrum, to which it is attached. The deep aspect of the ligament is attached to the bone beneath the lunate surface. To date, the function of this ligament is not fully understood²³ and is often regarded merely as a surgical obstacle during arthroplasty of the hip. We used it as a landmark to control the positioning of the acetabular component. This technique is independent of the position of the patient. Although it cannot determine the inclination of the cup accurately, we feel that this can be defined by reference to the residual posterior labrum, which again is almost always present.


We have shown that the transverse acetabular ligament can be classified into four grades. Although it is a relatively short structure it can be exposed in most cases, even when

using a minimally-invasive approach. In the three cases where it was absent, it is possible that the surgeon inadvertently destroyed a grade 3 ligament.

Using this technique, our rate of dislocation after surgery was 0.6%. Many factors are known to contribute to this complication, but correct placement of the acetabular component is critical.^{2,7,24} These results compare favourably with those of other published series using a posterior approach²⁵⁻³⁰ (Table II). A larger femoral head (32 mm) has been shown to be associated with a lower risk of dislocation,³¹ but we used a 28 mm head in all cases.

We conclude from this preliminary study that the transverse acetabular ligament can aid positioning of the acetabular component of a THR. It defines the version of the acetabular component without the need for external instrumentation, and is independent of the position of the patient. The low dislocation rate demonstrated in this study is consistent with the technique rather than necessarily attributable to it. It may not be applicable where a significant acetabular structural abnormality is present, as in severe dysplasia or following a pelvic fracture. These conditions were not encountered in our series of 1000 consecutive cases. Further work is being undertaken to determine how the position achieved by this technique relates to the suggested 'safe zones' on radiological assessment.^{1-4,6,7}

Supplementary Material

 A further opinion by Mr John Nolan is available with the electronic version of this article on our website at www.jbjs.org.uk

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